

WHAT IS CLAIMED IS:

1. An optical multilayer film comprising:
a first layer;
5 a second layer that contains titanium oxynitride
as a main component; and
a third layer that contains magnesium fluoride as
a main component;
the first layer that has a different refractive
10 index from that of the second layer or the third layer;
and
the first layer, the second layer, and the third
layer being part of a laminated structure that includes
a plurality of reflection planes,
15 the thickness of the third layer being smaller
than $1/4$ wavelength.
2. The optical multilayer film as claimed in
claim 1, wherein the first layer and the second layer
20 are in contact with each other.
3. The optical multilayer film as claimed in
claim 1, wherein another layer is interposed between
the first layer and the second layer.
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4. The optical multilayer film as claimed in
claim 1, wherein:
the first layer contains magnesium fluoride; and
the second layer is sandwiched by the first layer
30 and the third layer.
5. The optical multilayer film as claimed in
claim 1, wherein the first layer contains silicon oxide
as a main component.
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6. The optical multilayer film as claimed in
claim 1, wherein the optical multilayer film is a

reflection preventing film or a highly reflective film.

7. The optical multilayer film as claimed in claim 1, wherein the second layer is a layer formed by ion-assisted deposition.

8. An optical semiconductor device comprising an optical multilayer film that is located on an light incident plane or a light emitting plane,
10 the optical multilayer film having a laminated structure that at least includes a first layer, a second layer containing titanium oxynitride as a main component, and a third layer containing magnesium fluoride as a main component, the first layer having a
15 different refractive index from that of the second layer or the third layer,
the laminated structure having a plurality reflection planes,
the thickness of the third layer being smaller
20 than 1/4 wavelength.

9. The optical semiconductor device as claimed in claim 8, wherein the first layer and the second layer are in contact with each other.

10. The optical semiconductor device as claimed in claim 8, wherein another layer is interposed between the first layer and the second layer.

11. The optical semiconductor device as claimed in claim 8, wherein:
the first layer contains magnesium fluoride; and
the second layer is sandwiched by the first layer and the third layer.

12. The optical semiconductor device as claimed in claim 8, wherein the first layer contains silicon

oxide as a main component.

13. The optical semiconductor device as claimed
in claim 8, wherein the optical multilayer film is a
5 reflection preventing film or a highly reflective film.

14. The optical semiconductor device as claimed
in claim 8, wherein the second layer is a layer formed
by ion-assisted deposition.

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15. The optical semiconductor device as claimed
in claim 8, wherein at least the light incident plane
or the light emitting plane is sealed with resin.

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16. An optical semiconductor device comprising
an optical multilayer film that includes a
plurality of layers having different refractive indices
on a light incident plane or a light emitting plane,
the optical multilayer film being able to exhibit
20 first optical characteristics that are obtained by
causing a refractive index difference between an
outermost layer and the air or an inert gas, and second
optical characteristics that are obtained by not
causing a refractive index difference between the
25 outermost layer and a material existing on the external
side of the outermost layer, and
the first optical characteristics and the second
optical characteristics being substantially the same.

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17. The optical semiconductor device as claimed
in claim 16, wherein

the first optical characteristics and the second
optical characteristics both satisfy optical
requirements of a case where another material is
35 provided in contact with the outermost layer of the
optical multilayer film.

18. The optical semiconductor device as claimed in claim 16, wherein the second optical characteristics are obtained by providing resin in contact with the outermost layer of the optical multilayer film.

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19. The optical semiconductor device as claimed in claim 16, wherein the optical multilayer film includes a layer that contains titanium oxynitride as a main component, and a layer that contains magnesium fluoride as a main component.

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20. The optical semiconductor device as claimed in claim 8, further comprising a fourth layer having a refractive index higher than that of the first layer.

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